Circulation

AHA SCIENTIFIC STATEMENT

Assessing and Addressing Cardiovascular Health in People Who Are Transgender and Gender Diverse

A Scientific Statement From the American Heart Association

Endorsed by the American Academy of Physician Assistants

The American Medical Association affirms the educational benefit of this document.

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ABSTRACT: There is growing evidence that people who are transgender and gender diverse (TGD) are impacted by disparities across a variety of cardiovascular risk factors compared with their peers who are cisgender. Prior literature has characterized disparities in cardiovascular morbidity and mortality as a result of a higher prevalence of health risk behaviors. Mounting research has revealed that cardiovascular risk factors at the individual level likely do not fully account for increased risk in cardiovascular health disparities among people who are TGD. Excess cardiovascular morbidity and mortality is hypothesized to be driven in part by psychosocial stressors across the lifespan at multiple levels, including structural violence (eg, discrimination, affordable housing, access to health care). This American Heart Association scientific statement reviews the existing literature on the cardiovascular health of people who are TGD. When applicable, the effects of gender-affirming hormone use on individual cardiovascular risk factors are also reviewed. Informed by a conceptual model building on minority stress theory, this statement identifies research gaps and provides suggestions for improving cardiovascular research and clinical care for people who are TGD, including the role of resilience-promoting factors. Advancing the cardiovascular health of people who are TGD requires a multifaceted approach that integrates best practices into research, health promotion, and cardiovascular care for this understudied population.

Key Words: AHA Scientific Statements ■ cardiovascular disease ■ intersectionality ■ minority stress theory ■ social determinants of health ■ stigma ■ transgender

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Transgender and gender diverse (TGD) populations comprise a large and growing population in the United States (see Table 1 for glossary of terms[1]). Although estimates vary, ≈2% of high school–aged youth[2] and 0.5% to 0.6% of adults[3] in the United States identify as TGD. As noted in the National Academies of Sciences, Engineering, and Medicine Report on Sexual and Gender Minority (SGM) health,[4] people who are TGD face significant health disparities over the life course compared with their peers who are cisgender. Despite a heightened focus on the health of TGD populations in recent years, significant gaps in research and optimized and responsive clinical care remain. In the fiscal year of 2018, 19.8% of National Institutes of Health–funded SGM research projects included transgender populations, whereas 1.6% included individuals who are gender diverse (eg, nonbinary, gender nonconforming). Most of these studies focused on HIV infection, mental health, and substance use; it is notable that none had a focus on cardiovascular outcomes.[5]

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Table 1. Glossary of Terms

Cisgender	A term used to describe people whose gender identity is congruent with what is traditionally expected based on their sex assigned at birth.
Gender diverse	A term used to describe people whose gender identity is not constrained by binary concepts of gender.
Gender expression	The ways in which a person communicates femininity, masculinity, androgyny, or other aspects of gender, often through speech, mannerisms, gait, or style of dress. Everyone has ways in which they express their gender.
Gender identity	A person's inner sense of being a girl/woman, a boy/man, a combination of girl/woman and boy/man, something else, or having no gender at all. Everyone has a gender identity.
Gender minority	A broad diversity of people who experience an incongruence between their gender identity and what is traditionally expected based on their sex assigned at birth, such as people who are transgender and gender diverse.
Gender modality	Refers to the correspondence (or lack thereof) between one's assigned sex at birth and one's actual gender and/or gender expression. The 2 primary, and most well known, gender modalities are cisgender and transgender.[4a]
Gender nonbinary	A term used by some people who identify as a combination of girl/woman and boy/man, as something else, or as having no gender. Often used interchangeably with "gender nonconforming."
Gender nonconforming	A term used by some people who identify as a combination of girl/woman and boy/man, as something else, or as having no gender. Often used interchangeably with "gender nonbinary."
Queer	Historically a derogatory term used against LGBTQ people, it has been embraced and reclaimed by LGBTQ communities. Queer is often used to represent all individuals who identify outside other categories of sexual and gender identity. Queer may also be used by an individual who feels as though other sexual or gender identity labels do not adequately describe their experience.
Sex assigned at birth	Usually based on phenotypic presentation (ie, genitals) of an infant and categorized as female or male; distinct from gender identity.
Sex	Biological sex characteristics (chromosomes, gonads, sex hormones, and genitals); male, female, intersex. Synonymous with "sex assigned at birth."
Man who is transgender	Someone who identifies as male but was assigned female sex at birth.
Woman who is transgender	Someone who identifies as female but was assigned male sex at birth.

LGBTQ indicates lesbian, gay, bisexual, transgender, and queer or questioning. Data adapted from Caceres et al.[1]

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CARDIOVASCULAR OUTCOMES AMONG TGD POPULATIONS

A growing body of research demonstrates that TGD populations may be at disproportionate risk for poor cardiovascular outcomes.[1] Within the Behavioral Risk Factor Surveillance System (BRFSS), multivariable analyses of cross-sectional self-reported data revealed that men who are transgender had a >2-fold and 4-fold increase in the prevalence of myocardial infarction compared with men who are cisgender and women who are cisgender, respectively. Conversely, women who are transgender had >2-fold increase in the prevalence of myocardial infarction compared with women who are cisgender but did not have a significant increase in comparison with men who are cisgender.[6]

In analyses assessing the effects of hormone therapy on cardiovascular outcomes, data consistently demonstrate elevated risk for venous thromboembolism among people who are transgender receiving estrogen-based hormone therapy. In a retrospective cohort study using electronic health record (EHR) data, people who are transgender receiving feminizing hormone therapy were found to have a higher incidence of venous thromboembolism, with 2- and 8-year risk differences of 4.1 and 16.7 per 1000 people relative to men who are cisgender and 3.4 and 13.7 relative to women who are cisgender. The overall analyses for ischemic stroke and myocardial infarction demonstrated a similar incidence across groups. More pronounced differences for venous thromboembolism and ischemic stroke were observed among transgender participants who initiated estrogen-based hormone therapy during follow-up. The evidence was insufficient to allow conclusions regarding risk among transgender participants who initiated testosterone-based hormone therapy.[7] Additional studies and data sources (eg, the STRONG cohort [Study of Transition, Outcomes, and Gender],[8] the TransPop study [US Transgender Population Health Survey][9]) are, as of submission, still being composed and analyzed to allow for interpretation of the prevalence and incidence of cardiovascular outcomes.

In addition to these recent outcomes data, a growing body of research demonstrates that TGD populations experience disproportionate risk for poor cardiovascular health across multiple behavioral and social determinants of health.[1] To improve the health of people who are TGD, more studies investigating not only cardiovascular risk factors, but also mechanisms responsible for cardiovascular disparities are urgently

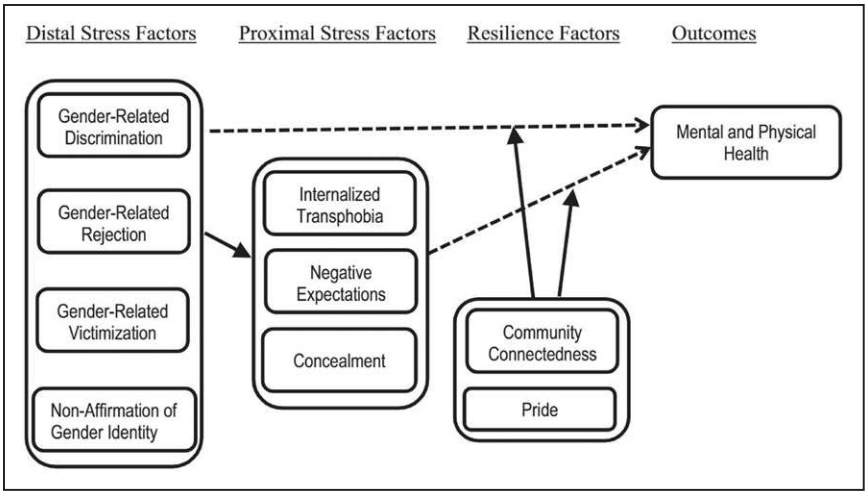

Figure 1. Gender minority stress and resilience model.
Minority stress and resilience factors in people who are transgender and gender diverse. Dashed line indicates inverse relationships. Copyright © 2015 by American Psychological Association. Reproduced with permission from Testa et al.[14]

needed. The objective of this scientific statement is to synthesize the literature describing cardiovascular health, and emerging cardiovascular risk factors and outcomes, as well, among TGD populations by using a theory-informed approach. The scientific statement uses Life's Simple 7 to describe traditional cardiovascular risk factors that shape cardiovascular health and explores evidence on emerging cardiovascular risk factors thought to impact the cardiovascular health of TGD populations.[10] The final section focuses on modifiable factors that can strengthen resilience-promoting efforts to improve cardiovascular health equity for TGD populations.

EXPANDING MINORITY STRESS THEORY: A CONCEPTUAL MODEL OF TGD CARDIOVASCULAR HEALTH

Minority Stress Theory (MST) has historically served as the leading theory to explain broad-ranging TGD health disparities.[11] The Gender Minority Stress and Resilience Model (Figure 1) depicts how distal and proximal minority stressors experienced by people who are TGD contribute to TGD health disparities.[12–14] Distal stressors include gender nonaffirmation (eg, being called by incorrect pronoun or name) and stigma, discrimination, rejection, and victimization based on gender identity.[2] Proximal stressors include internalized stigma or transphobia, negative expectations, hypervigilance, and concealment of gender identity.[15,16] Taken together, distal and proximal minority stressors are hypothesized to contribute to higher overall stress levels, which in turn reshape cardiovascular health behaviors, and increase the likelihood of broad-ranging poor mental and physical health outcomes, as well, including cardiovascular disease (CVD).

MST has been critiqued for not adequately capturing the effects of stigmatization at the intersections of multiple marginalized identities, structural-level factors, or resilience-promoting factors that influence the health of TGD populations.[11] Building from MST, Figure 2 therefore presents an expanded conceptual model. The Intersectional Transgender Multilevel Minority Stress Model depicts how stigmatization at the intersections of multiple marginalized identities and multilevel social determinants of health across the life course contribute to higher general and minority stressors impacting TGD cardiovascular health. Furthermore, the model depicts how resilience-promoting factors at the individual, interpersonal, and structural levels can counteract the effects of transphobic violence and stigma to promote TGD health equity.

A growing body of empirical research has demonstrated the harmful impact of minority stress on CVD among several minority groups including racial and ethnic minority adults[17,18] and sexual minority adolescents.[19] Research has been limited on the relationships between minority stressors and CVD for TGD populations.[20] Furthermore, research exploring resilience, the ability to bounce back from adversity, has been primarily focused on individual-level factors and mental health outcomes.[11,21,22] Resilience-promoting factors may decrease cardiovascular risk (eg, physical activity) and may counteract or buffer the effects of stigma (eg, social support). Ultimately, it is reasonable to expect that similar mechanisms linking minority stress and resilience-promoting factors to cardiovascular health in other populations apply to people who are TGD.

LIFE'S SIMPLE 7 CARDIOVASCULAR RISK FACTORS

Tobacco Use

Tobacco use is a well-established risk factor for CVD. The prevalence of tobacco use among TGD populations has been evaluated in several studies with conflicting results, in part, because of different sampling

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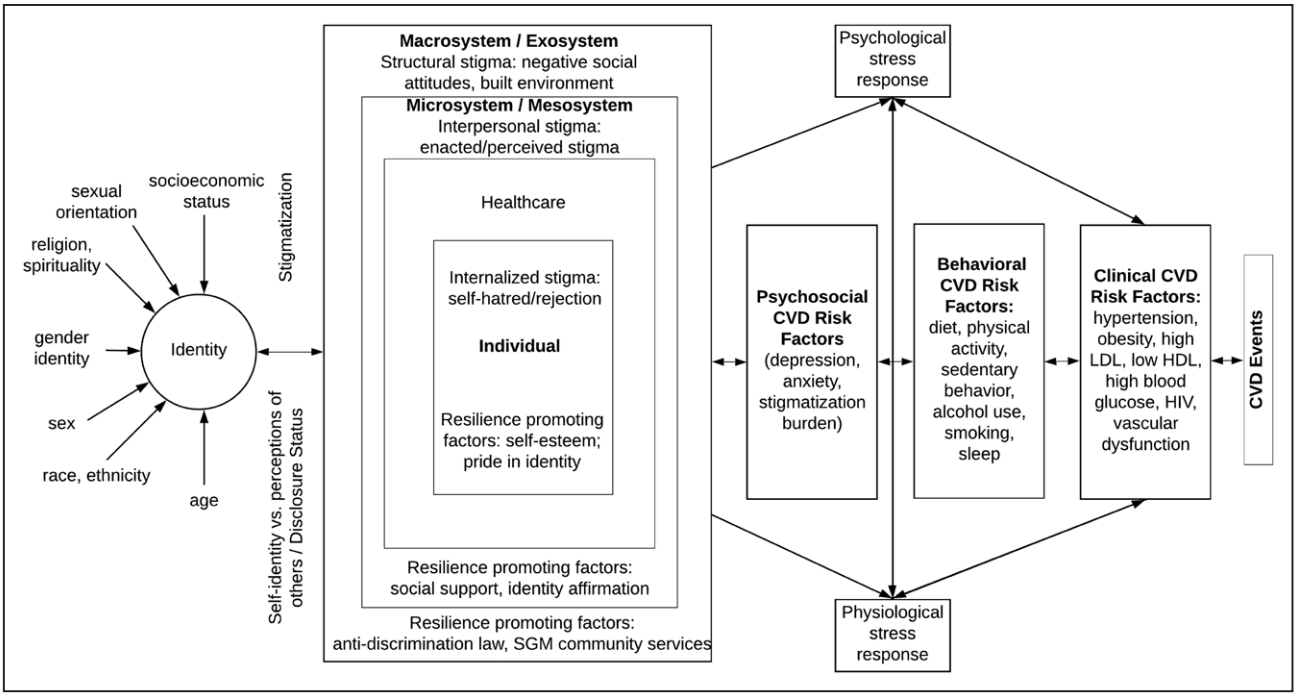

Figure 2. The intersectional transgender multilevel minority stress model.
CVD indicates cardiovascular disease; HDL, high-density lipoprotein; LDL, low-density lipoprotein; and SGM, sexual and gender minority.

techniques, methods to measure tobacco use, and ways of identifying people who are TGD. The US Transgender Survey, a nonprobability survey conducted with 28 000 people who are TGD, found that 23.6% of respondents currently smoked cigarettes,[23] a rate higher than the US population (17.6%). However, analyses of data from the 2014 and 2016 BRFSS, and the PATH study (Population Assessment of Tobacco and Health), as well, did not demonstrate a higher prevalence of current or former cigarette smoking in people who are transgender.[24,25] Applying MST, analyses of the US Transgender Survey revealed that experiencing discrimination accounted for significantly higher odds of cigarette smoking and dual cigarette use (ie, using both cigarettes and vaping). Furthermore, participants who believed they were visually gender nonconforming had greater odds of cigarette smoking, vaping, and dual use than those who reported they were visually gender conforming.[23] Tobacco use remains one of the most clinically significant modifiable risk factors of CVD for people who are TGD and should be considered in the context of minority stress and gender affirmation.

Physical Activity

The measurement of physical activity levels in people who are TGD is an understudied area. Survey data suggest that adolescents who are TGD are less likely than their peers who are cisgender to participate in regular physical activity, physical education classes, school athletics, or extracurricular activities.[26] The lack of participation in physical activity has been attributed to a tendency to feel unsafe or uncomfortable in school environments, especially those segregated by gender.[26] Similarly, adults who are TGD report participating in less physical activity than adults who are cisgender.[27,28] Data from the 2014 to 2016 BRFSS report that men who are transgender have a higher odds of reporting no exercise compared with people who are cisgender even after adjusting for socioeconomic factors and state.[28] Furthermore, research has found that 23% of older adults who are TGD reported low physical activity levels.[27] It is notable that adults who are TGD taking gender-affirming hormone therapy are more likely to be engaged in physical activity than those who are not, and the best predictor of participating in physical activity is high body satisfaction.[29] Although physical activity remains an essential modifiable factor of cardiovascular health, ensuring a safe and welcoming environment is a critical component of being able to engage in such protective health behavior.

Diet/Nutrition

Caloric intake, nutritional value, and access to adequate nutrition are modifiable factors in cardiovascular health, and are an expanding field of research in people who are TGD across the lifespan.[30] Survey data of adolescents who are TGD found less frequent intake of fruit and milk and more frequent intake of fast food and soft drinks than of peers who are cis-

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gender.[26] In addition to inadequate nutrition, adolescents who are TGD disproportionately self-report unsafe weight management behaviors (ie, fasting, diet pill use, laxative abuse) and being diagnosed with an eating disorder compared with peers who are cisgender.[31] After reviewing the literature, there remains a clear methodological gap exploring dietary intake, validity and reliability of nutrition assessment methods, and nutritional interventions for people who are TGD across the lifespan.[30]

Weight Management

BRFSS data reveal a significantly higher prevalence of self-reported body mass index (BMI) >25 kg/m^2 among people who are TGD compared with adults who are cisgender (72.4% versus 65.5%).[32] Given the effects of estrogen and testosterone on fat distribution, muscle mass, and visceral fat,[33–37] the effects of gender-affirming hormone therapy have been investigated. A recent investigation found that the lean mass of men who are transgender on hormones was higher than among BMI-matched women who are cisgender, but lower than that of BMI-matched men who are cisgender.[38] Studies reporting associations between hormone use and BMI have had mixed results. A systematic review of studies evaluating the effects of testosterone use on BMI in men who are transgender revealed significant increases (1.3%–11.4%) in BMI.[39] Follow-up in these studies was between 6 months and 2 years, and most men who are transgender used injectable testosterone undecanoate. However, a US longitudinal study investigating BMI changes over 7 years did not demonstrate an increase in BMI among men who are transgender.[37] In adolescents, the use of testosterone similarly shows contradictory results.[40–42]

Among women who are transgender receiving estrogen, 1 study found that compared to BMI-matched men and women who are cisgender, percent lean mass was lower and higher, respectively.[38] The effect of estrogen use on BMI among women who are transgender is unclear; European studies have shown an increase in BMI,[42–46] waist circumference, and weight,[44] whereas several US studies have not demonstrated an increase in BMI.[40,41,47] These results may be attributable to differences in duration of follow-up, and to differences in hormone prescription practices across regions, as well: cyproterone acetate and gonadotropin releasing hormone analogs are often used in Europe, whereas spironolactone is used in the United States for androgen blockade.

It is notable that access to gender-affirming surgical interventions often comes with BMI cutoffs, which may affect diet, exercise, and weight management among people who are TGD. Although accessing gender-affirming care has been associated with improved quality of life, meeting BMI cutoffs to access this care may cause additional undue stress for people who are TGD.

Lipid Profile

Lipid profiles are one of the most well-studied cardiovascular risk factors among TGD populations over the life course. An observational study of TGD youth assigned male at birth recruited before any hormonal intervention found no differences in total or low-density lipoprotein cholesterol.[48] However, lower levels of high-density lipoprotein (HDL) cholesterol were detected, independent of BMI, race, or socioeconomic status between TGD youth and a National Health and Nutrition Examination Survey comparison group.[48] Studies conducted among people who are TGD taking hormone therapy have revealed that, similar to people who are cisgender, hormone therapy affects the lipid profiles of people who are TGD.[38] Cross-sectional comparisons of youth who are transgender receiving hormone therapy compared with cisgender controls showed that adolescent men who are transgender had lower HDL cholesterol than matched adolescent women who are cisgender, whereas adolescent women who are transgender had higher HDL cholesterol than adolescent men who are cisgender[38]; no differences in total or low-density lipoprotein cholesterol or triglycerides were noted.[49]

An analysis of 2014 to 2017 BRFSS data found no differences in self-reported hypercholesterolemia between TGD and cisgender adults; gender-affirming hormone use is not measured in the BRFSS.[6] Among adult men who are transgender, testosterone therapy has been consistently associated with decreased HDL cholesterol ranging from 3.4% to 23.4% and increased triglycerides ranging from 17.5% to 44%,[47,50,51] with some studies also noting increases in total and low-density lipoprotein cholesterol ranging from 3.6% to 18.7%.[51,52] The lipid and lipoprotein levels following testosterone therapy were still in the desirable range.

Among women who are transgender, the effects of estrogen therapy on lipid profiles are discrepant with favorable, unfavorable, and no changes being reported. In sensitivity analyses conducted to decrease confounding between age and hormone regimens, larger decreases in lipids were observed in women 30 to 45 years of age who are transgender who were receiving transdermal estradiol plus daily cypionate acetate compared with their age-matched peers receiving oral estradiol plus cypionate acetate.[45] In contrast to the reported favorable effects of estrogen therapy on lipids, a meta-analysis showed that estrogen therapy was associated with an increase in triglycerides without significant changes in total cholesterol or other lipoprotein fractions.[53] It is speculated that the increase in triglycerides was driven by the use of oral estrogens, because sensitivity analyses showed an increase in tri-

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glycerides of 28.2 mg/dL ([95% CI, 0.5–55.9 mg/dL] I^2=0%) with oral estradiol compared with a decrease of 4.8 mg/dL ([95% CI, −21.2 to 11.6 mg/dL] I^2=0%) with transdermal estradiol.[53] The differential effects between oral and transdermal estradiol on triglycerides is a phenomenon that has been previously reported in postmenopausal women who are cisgender.[54] Collectively, there do not appear to be adverse effects of estrogen therapy on blood lipids and lipoproteins in women who are transgender, with the exception of possible increases in triglycerides and decreases in HDL cholesterol depending on the type of antiandrogen coadministered with estradiol.

In summary, changes across lipid profiles in people who are TGD attributable to gender-affirming hormone therapy are measurably small and of unknown, if any, clinical significance. Future studies should focus on analyzing the effects of hormone therapy on lipid profiles among older people who are TGD.

Glycemic Status

Few studies have evaluated the prevalence of diabetes in people who are TGD. In the 2015 BRFSS, no difference in the prevalence of self-reported diabetes between women who are transgender and men and women who are cisgender was detected; men who are transgender had lower odds of self-reported diabetes than men who are cisgender.[55] However, a study from the Netherlands found that men and women who are transgender had a higher prevalence of diabetes than people who are cisgender, both before and after using hormone therapy.[56] A systemic review assessing the effect of testosterone on insulin resistance, overall, found no apparent negative effect of testosterone on insulin resistance, with only 2 of 13 studies showing increased insulin resistance, whereas the majority showed no effects (10 studies), and 1 study demonstrated improvements in insulin sensitivity.[57] For women who are transgender receiving estrogen, 5 of 8 studies showed increased insulin resistance, whereas 3 found no effect.[57] Another study showed that insulin sensitivity and post–oral glucose tolerance test incretin responses decreased with estrogen treatment.[46] Overall, research exploring the effects of gender-affirming hormone therapy on the acquisition of diabetes provides contradictory results and points to the need for more research using longitudinal data.

Blood Pressure

Evidence of elevated blood pressure in TGD populations is limited. Most research on hypertension in adults who are TGD has focused on the impact of hormone therapy on blood pressure. Multiple systematic reviews indicate that findings are inconclusive with studies reporting small but not clinically significant elevations in systolic blood pressure among men who are transgender.[49,58] Likewise, a recent retrospective cohort study that examined EHRs of men and women who are transgender (N=4402) found no significant associations between hormone use and hypertension in men who are transgender.[59] Among women who are transgender, a higher blood concentration of testosterone was associated with higher odds of having hypertension.[59] However, data from BRFSS have noted lower rates of hypertension among men who are transgender than among men who are cisgender.[6] In addition, investigators found that women who are transgender who had received a progestin prescription had lower odds of having hypertension.[59] To date, there has been limited investigation of potential social determinants of hypertension in people who are TGD, which thereby remains an important area for future research.

ADDITIONAL RISK FACTORS AND CONSIDERATIONS

HIV Infection

Rates of CVD are significantly higher for people living with HIV than for uninfected peers and persist even after sustained viral suppression with effective antiretroviral therapy is achieved.[60] This risk is particularly relevant for adults who are TGD who experience a disproportionate burden of HIV. The most recent laboratory-confirmed HIV prevalence estimates indicate that 14% of women who are transgender and 2% of men who are transgender are living with HIV, respectively.[61] Racial disparities in HIV infection among women who are transgender are also marked, with 44% of Black women who are transgender and 25% of Latina women who are transgender with HIV, respectively.[61] Disaggregated data on people who are TGD with HIV are limited. However, existing research suggests that people who are TGD with HIV may be at even higher risk for CVD than people who are cisgender with HIV.[62] Understanding this difference in CVD among those living with HIV requires additional research following best practices for research among people who are TGD.

Vascular Health and Function

Vascular dysfunction, featuring endothelial dysfunction and large elastic artery stiffening, is a key antecedent in the development of CVD and independently predicts cardiovascular events.[63] In addition to traditional clinical CVD risk factors, psychosocial and physiological stress responses are associated with vascular dysfunction (Figure 2).[64] However, to our knowledge, no data exist

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that describe vascular dysfunction among people who are TGD independent of studying the effects of gender-affirming hormone therapy. Although estrogen and testosterone treatment, in general, are associated with enhanced endothelial function and reduced large elastic artery stiffness (or increased arterial compliance) in adults who are cisgender,[65–67] limited data are available regarding vascular function in adults who are TGD and, to our knowledge, no data regarding vascular function are available for youth who are TGD.

Cross-sectional comparisons between men who are transgender receiving testosterone cypionate compared with age-matched women who are cisgender found reduced endothelial function measured via brachial artery flow-mediated dilation.[68] In a cross-sectional study, arterial stiffness, measured via brachial-ankle pulse wave velocity and carotid augmentation index, showed higher brachial-ankle pulse wave velocity (ie, greater stiffening) in men who are transgender receiving testosterone than in men who are transgender not receiving hormone therapy.[52] Because there were no differences in carotid augmentation index, a measure of large elastic artery stiffness, the significance of a higher brachial-ankle pulse wave velocity, a measure of muscular artery stiffness, is unclear.

In contrast to data in men who are transgender, endothelial function has been reported to be enhanced and arterial stiffness reduced in women who are transgender receiving hormone therapy. Brachial artery flow-mediated dilation was higher in women who are transgender treated with estrogen than in age-matched men who are cisgender, but was similar to women who are cisgender.[69] In the only study that we are aware of to examine endothelial function at the microvascular (ie, resistance vessel) level, women 30 to 60 years of age who are transgender receiving estrogen had a greater forearm blood flow response to acetylcholine, an endothelial-dependent vasodilator, than age-matched men who are cisgender.[70]

Furthermore, people who are TGD who had undergone gender-affirming surgery and were receiving hormone therapy had reduced brachial artery flow-mediated dilation compared with women and men who are transgender who had not undergone surgery but who were taking hormone therapy.[71] In secondary analyses, the results remained the same when separating by gender identity. However, the sample sizes in the surgery group likely lacked the power to detect differences.[71] Overall, studies of vascular dysfunction among individuals who are TGD are limited to adults receiving hormone therapy, and these studies are in turn limited in number, size, and scope.

Sleep

Inadequate sleep duration and poor sleep quality have been identified as risk factors for incident hypertension, diabetes, and CVD.[45] A recent review of sleep among SGM populations found that only 4 studies had been conducted that examined sleep health among adults who are TGD.[72] A qualitative study of 40 adults who are TGD living in New York City found that >35% of participants attributed sleep problems to gender identity concerns.[73] In addition, a study of adults who are TGD found that internalized transphobia and sexual victimization were positively associated with sleep disturbances, whereas resilience-promoting factors (ie, community connectedness) were negatively associated with sleep disturbances.[74] The study of sleep in adults who are TGD is an emerging area of research that warrants further investigation.

Alcohol

Studies of TGD alcohol use are sparse, and a 2018 systematic review found methodological weaknesses and limited measurement of alcohol use outcomes in people who are TGD. Data from the 2017 Youth Risk Behavior Surveillance System showed that youth who are transgender were more likely than youth who are cisgender to report lifetime alcohol use.[2] Additional research reports elevated patterns of alcohol use for TGD versus cisgender youth,[75] and a clear association between past-year experiences of bullying and alcohol use for youth who are TGD, as well.[75,76] Furthermore, research in adults who are TGD has demonstrated elevated levels of alcohol use compared with the general population, including distinct patterns of use based on gender identity, sex assigned at birth, and sexual orientation. One recent study that broke down the odds of binge drinking among adults who are TGD by sex and gender identity found lower odds of self-reported binge drinking in men who are transgender than in men who are cisgender, higher odds of self-reported binge drinking in women who are transgender than in women who are cisgender, and lower odds of self-reported binge drinking in gender-nonconforming adults with a recorded female sex than in women who are cisgender.[38] Although data remain limited, studies have detected elevated rates of drinking in TGD populations and demonstrate that victimization and minority stress are associated with higher levels of alcohol use among TGD populations.

LIMITATIONS OF EXISTING RESEARCH

Lack and Limitations of Existing Data

The current lack of standardized gender identity data across various sources limits our examination of the prevalence, incidence, and disparities in cardiovascular health among TGD populations. Existing population-based surveys rely on self-report of cardiovascular outcomes, which lack clinical factors and biomarkers

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relevant to current measures of cardiovascular health. Existing longitudinal studies of cardiovascular health do not collect gender identity data, thereby invisibilizing individuals who are TGD and limiting the opportunities to report objective measures (eg, laboratory values) of cardiovascular health. Analyses of claims-based data sets erase the possibility of examining cardiovascular health across gender identities beyond the binary categories of man/woman and transgender man/woman. Although community-informed studies exist, such as the Patient-Centered Outcomes Research Institute–funded PRIDE study (Population Research in Identity and Disparities for Equality),[77] they are limited by using self-reported data rather than objective clinical measures. EHRs that appropriately collect gender identity data often lack complete clinical data and do not allow for generalizability of health outcome results beyond the health system or clinics examined.[78] It is important to recognize that EHR data exclude people who are TGD who are not engaged in health care, or who feel uncomfortable disclosing their status as transgender or gender diverse to clinicians.[78a] In addition, many EHR systems lack the ability to capture sociocultural factors relevant to understanding cardiovascular health (eg, MST processes). Overall, however, EHR data represent an advance in the absence of other sources of objective measures of cardiovascular health.

Testing of Mechanisms

There is a lack of understanding about mechanisms that link TGD-specific stressors to cardiovascular health. Insufficient evidence concerning the causal pathways responsible for elevated cardiovascular risk inhibits the development and testing of interventions to improve cardiovascular health. Despite increased CVD risk, no evidence-based interventions for CVD risk reduction specific to people who are TGD currently exist. Longitudinal research is needed to better characterize pathways from distal and proximal stressors to cardiovascular outcomes and to identify psychosocial and behavioral targets for interventions to improve the cardiovascular health of people who are TGD over the life course (Figure 2).

Qualitative research is needed to understand how cultural and neighborhood-level contextual factors influence the health of diverse TGD subpopulations. Increasing knowledge about group-specific attitudes and beliefs regarding health behaviors is needed to enhance the acceptability of interventions designed to improve the cardiovascular health of people who are TGD. These interventions should account for the influence of interpersonal and structural drivers of cardiovascular health in people who are TGD, including intersectionality of multiple marginalized social identities (eg, being both TGD and a person of color).

Social and Clinical Determinants of Cardiovascular Health

How social determinants of health and minority stress influence CVD risk factors and outcomes has been well characterized among marginalized racial and ethnic populations.[79] However, qualitative and quantitative research studies exploring how these pathways influence cardiovascular health among people who are TGD are only now being conducted. Empirical studies have found that stigmatization of people who are TGD vary by other intersectional stigmatized and marginalized characteristics (eg, race, class). However, limited research has examined social determinants (eg, social and community contexts) of cardiovascular health among people who are TGD.

In addition, there is evidence that gender-affirming hormones reduce psychosocial and behavioral risk factors in people who are TGD. Therefore, the potential cardiovascular effects of gender-affirming hormone therapy should be evaluated against the benefits for mental health, health behaviors, and downstream physiological health effects (Figure 2).

Suggestions for Research and Clinical Practice

Primary prevention of CVD relies on the accuracy of prediction models and the data utilized to create them. However, current prediction models (eg, Pooled Cohort Risk Assessment Equation) are limited because of prior research using binary categories of male and female that exclude people who are transgender.[4,49] Although population-based studies have provided a greater understanding of the cardiovascular health of people who are TGD, the data on relevant social and clinical determinants for people who are TGD remain scarce. Only 3 cardiovascular cohorts currently have plans to collect gender identity data (ie, CARDIA [Coronary Artery Risk Development in Young Adults Study], HCHS/SOL [Hispanic Community Health Study/Study of Latinos], and the RURAL study [Risk Underlying Rural Area Longitudinal]). Current and future National Institutes of Health–funded cardiovascular cohort studies should include standardized measures of gender identity and expression that will permit data harmonization to achieve larger samples of understudied groups within TGD populations.[78]

Several steps should be taken to increase the trust that people who are TGD have in the research community (Table 2). An important mantra in doing any research focused on minoritized and marginalized populations should be "nothing about us without us." Consequently, research teams conducting TGD research should reflect the diversity that exists within the population. Researchers should also partner with TGD communities during all stages of the scientific process to increase trust in research and ensure that research agendas are informed by and aligned with community needs.[80]

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Table 2. Suggestions for Research and Clinical Practice With People Who Are Transgender and Gender Diverse

Cardiovascular research
Develop standardized sexual orientation and gender identity measures and integrate these in current and future National Institutes of Health–funded cardiovascular prospective cohort studies to allow for data harmonization.
Integrate biobehavioral measures into cardiovascular research with TGD populations.
Interrogate research methods and choose measures that avoid perpetuating discrimination (eg, reevaluate the use of body mass index as a measure of body composition).
Leverage electronic health record data to increase understanding of TGD cardiovascular health.
Partner with TGD communities for measurement development, study design and conduct, and research dissemination to ensure that research reflects the needs of people who are TGD, especially stigmatized groups.
Develop and test multilevel interventions for cardiovascular risk reduction in adults who are TGD.
Examine social and clinical determinants of cardiovascular health in adults who are TGD.
Characterize the role of resilience in buffering the cardiovascular effects of stress in people who are TGD.
Clinical practice
Ensure collection of sexual orientation and gender identity data in electronic health records.
Educate and train health care professionals on TGD health disparities and the proper assessment of sexual orientation and gender identity in health care settings.
Incorporate TGD content in the curricula of health profession schools and postgraduate training (eg, continuing education requirements).
Require continuing education on TGD health for all practicing clinicians that includes content on cardiovascular health disparities.
Incorporate broader concepts of sex and gender in utilizing prediction models of cardiovascular disease.

TGD indicates transgender and gender diverse.

Clinical Training and Care

Many institutions acknowledge the paucity of education in TGD health. Yet, efforts to instill these topics into clinical curricula has been subsumed by the larger topic of SGM health inequity.[81] Although broader SGM content is needed, a curriculum that specifically encompasses the unique issues that affect people who are TGD can improve TGD-specific care: gender-affirming hormone therapy and surgical procedures, and anatomy-based preventive health.[82] A collaborative effort with organizational-level mandates across governing bodies to improve clinical competencies and didactic education during training across the health professions and specialties would serve to enhance effective clinical practice and compassionate care for people who are TGD.

Critical to improving TGD health and access to appropriate health care is creating welcoming and compassionate spaces and clinical care teams (Table 2). Health care institutions and organizations must commit to this goal and measure their success by using national benchmarking tools that evaluate health care institutional policies and practices to achieve equity and inclusion.

Since 2018, the ability to record sexual orientation and gender identity data has been required as one of the EHR meaningful-use criteria, but culturally responsive care requires additional steps to ensure appropriate collection and use of such data. In addition to recording affirmed name and pronouns, it is critical that clinicians obtain an anatomy inventory when appropriate. Assumptions about anatomy based on a patient's identified gender may lead to poor clinical decision making in the diagnosis and treatment of CVD. Therefore, all providers trained in cardiovascular health must understand such issues.

CONCLUSIONS

People who are TGD experience significant stressors that affect cardiovascular health across the lifespan. In addition to disparities across traditional risk factors for CVD, people who are TGD experience unique disparities in relation to TGD-specific factors that further impact cardiovascular health and CVD. In addition, the use of gender-affirming hormone therapy may be associated with cardiometabolic changes, but health research in this area remains limited and, at times, contradictory. To address knowledge gaps in the literature, longitudinal research that examines mechanisms that link social and clinical determinants with cardiovascular health in people who are TGD across the lifespan is needed. Theory-driven research that also attends to both general and TGD-specific vulnerabilities and identifies health-promoting resiliencies will further inform future intervention targets. Last, TGD health content must be incorporated in health professions training, accreditation, and licensure requirements. There are exciting opportunities for future research, clinical, and public health efforts to better understand and reduce cardiovascular health disparities among people who are TGD.

ARTICLE INFORMATION

The American Heart Association makes every effort to avoid any actual or potential conflicts of interest that may arise as a result of an outside relationship or a personal, professional, or business interest of a member of the writing panel. Specifically, all members of the writing group are required to complete and submit a Disclosure Questionnaire showing all such relationships that might be perceived as real or potential conflicts of interest.

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Disclosures

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Lauren B. Beach	Northwestern Medical Social Sciences	NIH (R01 HL149866†, L60 MD011099†, K12 HL143959†, P30 AI117943 [D'Aquila])*; Northwestern University (Northwestern primary care practice-based research program pilot grant)*	None	Rutgers University CFAR*	None	None	National LGBT Cancer Network*	Northwestern Feinberg School of Medicine (research assistant professor)†
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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

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Loren Bauerband	University of Missouri	None	None	None	None	None	None	None
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